Remarks

The Office Action dated September 3, 2010, has been received and carefully reviewed. The preceding amendment and the following remarks form a full and complete response thereto. Claim 19 has been amended. Support for the amendment may be found, for example, in Applicants' specification at page 11, lines 1-31. No new matter has been added. This amendment does not require further search and/or consideration because the Examiner has already agreed that the amendment overcomes the rejection under 35 U.S.C. § 112, first paragraph, and the amendment is consistent with the interpretation given by the Examiner to the claim in rejecting claim 19 over the prior art. Applicants respectfully request reconsideration of the withdrawal of the rejections.

Examiner Interview

Applicants and Applicants' representatives wish to thank Examiner Arciero for extending the courtesy of the interview held on October 12, 2010, and for the thorough and courteous discussions. Applicants' representatives believe that prosecution of the present application was materially advanced based on the discussion of the pending claims, the Examiner's rejections, and the cited references. Agreement was reached that the restriction requirement, which was based on restriction practice pursuant to 37 CFR §§ 1.141-1.146, and withdrawal from consideration of claim 49 was improper because (a) unity of invention is applicable in national stage applications submitted under 35 U.S.C. § 371, and (b) claims 1 and 49 recite similar subject matter. In addition, agreement was reached that amending claim 19 to specify that "at least one of the positive and negative electrodes has an electrode surface which is essentially free

of hydroxide ions" would overcome the rejection under 35 U.S.C. § 112, first paragraph. Although agreement was not reached with regard to the prior art rejections, the Examiner indicated that arguments further explaining the structural differences between the claimed invention and the prior art would be useful in overcoming the rejections.

Election/Restrictions

Claim 49 was withdrawn from consideration as being directed to an invention that is a distinct species from the constructively elected invention recited in the original claims. Applicants respectfully traverse the election/restriction requirement and withdrawal from consideration of claim 49.

First, the Examiner's determination that distinct species are present is based on restriction practice pursuant to 37 CFR §§ 1.141-1.146. *See* Office Action at pp. 2-3 (citing 37 C.F.R. § 1.142(b)). According to the MPEP, "unity of invention (not restriction practice pursuant to 37 CFR 1.141 - 1.146) is applicable … in national stage applications submitted under 35 U.S.C. 371." MPEP § 1893.03(d). The application is a national stage application submitted under 35 U.S.C. 371, and the restriction does not apply the correct "unity of invention" standard.[1]

Second, the Examiner's election/restriction requirement was also improper because it was made in a final Office Action. Under 37 C.F.R. § 1.499:

[1] Even if restriction practice pursuant to 37 C.F.R. §§ 1.141 - 1.146 were applicable, restriction would still have been improper because claims 1 and 49 are drawn to the same invention. Claim 49 recites the "insulator" using "means for" (i.e., means-plus-function) language while claim 1 explicitly recites the structure of the "insulator." "Where the claims of an application define the same essential characteristics of a *single* disclosed embodiment of an invention, restriction therebetween should never be required." MPEP § 806.03 (explaining that "[t]his is because the claims are not directed to distinct inventions; rather they are different definitions of the same disclosed subject matter, varying in breadth or scope of definition").

> If the examiner finds that a national stage application lacks unity of invention under § 1.475, the examiner may in an Office action require the applicant in the response to that action to elect the invention to which the claims shall be restricted. Such requirement may be made before any action on the merits but may be made at any time **before** the **final action** at the discretion of the examiner.

37 C.F.R. § 1.499 (emphasis added). Accordingly, although the Examiner has discretion to require election/restriction for lack of unity any time before a final action, the Examiner's election/restriction requirement in a final rejection was improper.

Third, the election/restriction requirement was improper because, under the applicable unity of invention standard, the claims are so linked as to form a single general inventive concept. *See* 37 C.F.R. § 1.475(a). For example, claims 1 and 49 each recites "a negative electrode, an electrolyte containing a conductive salt [and based on SO_2], and a positive electrode." Further, each of claims 1 and 49 recites an "insulator." Claim 49 recites the "insulator" using "means for" (i.e., means-plus-function) language while claim 1 explicitly recites the structure of the "insulator." Accordingly, the requirement of unity of invention is fulfilled because "there is a technical relationship among those inventions involving one or more of the same or corresponding special technical features." 37 C.F.R. § 1.475(a).

Applicants respectfully request that the election/restriction requirement be **withdrawn**. In addition, because claim 49 has not been examined on the merits, Applicants respectfully request that the Examiner **reopen prosecution** and examine claim 49 on the merits.

Rejection of Claims under 35 U.S.C. § 112

Claims 19 and 38-48 were rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement. Applicants respectfully traverse this rejection for the following reasons.

Claim 19 has been amended to specify that "at least one of the positive and negative electrodes has an electrode surface which is essentially free of hydroxide ions." Support in the as-filed specification may be found, for example, at page 11, lines 1-31. As noted above, during the Examiner Interview, the Examiner agreed that this amendment would overcome the rejection under 35 U.S.C. § 112, first paragraph. Further, the Examiner has acknowledged that "[t]he present specification supports a cell comprising a negative electrode, an electrode containing salt, and a positive electrode, wherein one of the electrodes has a surface which is essentially from of hydroxide ions." Office Action at p. 4. Accordingly, Applicants respectfully submit that the claims do not contain new matter and respectfully request reconsideration and withdrawal of the rejections.

Rejection of Claims under 35 U.S.C. § 102

Claims 1-6, 17-19, 30-34 and 37-48 were rejected under 35 U.S.C. § 102(b) as being anticipated by International Publication No. WO 00/79631 to Hambitzer *et al.* ("Hambitzer '631") with the corresponding U.S. Patent No. 6,730,441 serving as the English equivalent.[2] Applicants respectfully traverse this rejection for the following reasons.

[2] As in the Office Action, cites to the text of Hambitzer '631 refer to U.S. Patent No. 6,730,441.

Independent Claim 1

During the interview, the Examiner requested further explanation about how the claimed invention is structurally different from (a) a conventional battery cell having a separator between the negative and positive electrodes, and (b) the battery cell of Hambitzer '631 having a porous salt structure and separator between the negative and positive electrodes. *See* Hambitzer '631 at col. 5, lines 1-40; col. 7, lines 1-2; and col. 8, lines 49-51.

In regard to (a), the "porous insulator layer" recited in claim 1 is structurally different than a separator due to the size of the pores. According to Applicants' specification:

> The pores of the insulator layer must be sufficiently large to permit the desired growth of the active mass through the layer and up to the surface of the positive electrode. In addition, the structure and the arrangement in relation to the positive electrode must be such that the contact between the active mass and the positive electrode is restricted to local sites (partial areas) of the electrode surface, so that only local short-circuits occur which do not lead to a reaction of further lithium (which is present in the porous insulator layer or at other parts of its boundary to the negative electrode). If a local short-circuit triggers further short-circuits, an uncontrolled reaction of the lithium, i.e. a "thermal runaway", would have to be expected due to the strong temperature increase.
>
> A suitable structure of the porous insulator layer must be established individually for each particular cell construction. It is to be taken into account that the diameter of the whiskers formed during deposition of the lithium is different from cell to cell. This is shown especially clearly by comparing cells operating with different electrolytes. If an organic electrolyte is used, the whiskers generally have substantially larger diameters than if an electrolyte based on SO_2 is used. Therefore, it is well possible that a layer having a specific porosity prevents the penetration (growing through) of whiskers in a first cell construction, thus acting as a separator, while in another cell, the same layer is penetrated by the deposited active mass.
>
> For this and other reasons, it is practically impossible to provide numerical values or other quantitative information about the pore size of suitable insulator layers. In addition, typical specification data of manufacturers of porous layer materials, such as "average pore size" and "maximum pore size" can in the present case not be used for characterizing suitable layer materials, because the

> pore size distribution is of substantial significance. For example, a layer which has a high percentage of extremely fine pores, but has a sufficient number of coarser pores through which the active mass may grow, may be suitable. The suitability of a layer material for fulfilling the function described here can, however, be tested experimentally without problems, as will be described in greater detail below.

Applicants' specification at p. 7, line 15–p. 8, line 14. Thus, a separator has pores small enough to prevent active mass from growing therethrough (while still allowing ionic charge transfer by migration of ions of the conducting salt dissolved in the electrolyte solution), but the recited "porous insulator layer" of claim 1 has pores large enough to permit active mass to grow therethrough.

This structural difference between the recited "porous insulation layer" and a conventional separator is recited in the claims, which specify that the "porous insulator layer … is arranged and formed such that it is possible for active mass deposited on the negative electrode to grow during the charging of the cell through the pores of the insulator layer to the surface of the positive electrode." A separator does not have a structure that makes it "possible for active mass deposited on the negative electrode to grow during the charging of the cell through the pores of the insulator layer to the surface of the positive electrode," as recited in claim 1.

In regard to (b), the "porous insulator layer" recited in claim 1 is structurally different than the battery cell of Hambitzer '631 having a porous salt structure and a separator between the negative and positive electrodes because the structure of recited "porous insulator layer" **does not include a separator** that prevents active mass from growing to the positive electrode. Applicants' specification discloses that "[a]n important feature is that no separator is present between electrodes 3 and 5." Applicants' specification at p. 20, lines 17-18. Here again, this

structural difference between the recited "porous insulator layer" and the porous salt structure and a separator of Hambitzer '631 is recited in claim 1, which specifies that the "porous insulator layer ... is arranged and formed such that it is possible for active mass deposited on the negative electrode to grow during the charging of the cell through the pores of the insulator layer to the surface of the positive electrode." If a separator were present, the separator would prevent active mass deposited on the negative electrode to grow during the charging of the cell through the pores of the insulator layer to the surface of the positive electrode.

Applicants respectfully submit that claim 1 is not anticipated by Hambitzer '631 because Hambitzer '631 does not disclose each and every feature of claim 1. For example, In addition, Hambitzer '631 does not disclose "a porous insulator layer ... arranged and formed such that it is possible for active mass deposited on the negative electrode to grow during the charging of the cell through the pores of the insulator layer up to the surface of the positive electrode," as recited in claim 1. The "arranged and formed" phrase limits the structure of the claimed "porous insulator layer" to only those structures that make it "possible for active mass deposited on the negative electrode to grow during the charging of the cell through the pores of the insulator layer up to the surface of the positive electrode."

The Examiner alleges that the separator of Hambitzer '631 corresponds to the claimed "porous insulator." *See* Office Action at p. 4. As is explained in the portion of the Handbook of Battery Materials ("Handbook") attached to the Applicants' Reply filed June 1, 2010, separators "keep the positive electrode physically apart from the negative [electrode] in order to prevent any electric current passing between them." Handbook at § 9.1.1. Separators have pores which permit an ionic current to pass therethrough but have a small enough diameter "to prevent

electronic bridging by deposition of metallic particles floating in the electrolyte." *Id.* Thus, in sharp contrast to the claimed "porous insulator," which has pores that **permit** active mass to grow therethrough, a separator has pores that **prevent** active mass from growing therethrough.

The Examiner relies on col. 5, lines 25-40 of Hambitzer '631 as teaching that "with respect to pore size, the porous layer should be formed and arranged such that the active mass formed on the negative electrode during charging of the cell, **penetrates into the pores <u>of the separator</u>**." Office Action at pp. 5, 12 and 13 (emphasis added). In doing so, the Examiner has mischaracterized the disclosure of Hambitzer '631, which actually discloses that "the porous [salt] structure should be formed and arranged in such a manner that the active mass which is formed at the negative electrode during the charge of the cell, **penetrates into the pores <u>of the porous salt structure</u>**." Hambitzer '631 at col. 5, lines 33-37 (emphasis added). The Examiner's mischaracterization reveals the Examiner's fundamental misunderstanding of Hambitzer '631. The Examiner has apparently failed to appreciate that the separator and the porous salt structure of the additional salt are **different** components. *See Id.* at col. 8, lines 49-51 ("**Salt addition** … between electrode and **separator**."). The disclosure in Hambitzer '631 that active mass may penetrate into pores of the porous salt structure of the additional salt is **not** a disclosure that active mass may penetrate into pores of the separator. Hambitzer '631 does not disclose that active mass penetrates into or through pores of the separator of Hambitzer '631. Thus, even though active mass formed at the negative electrode during charge of the cell may penetrate into the pores of the porous salt structure of the additional salt of Hambitzer '631, the active mass is not capable of penetrating through the pores of the separator of Hambitzer '631.

The separator of Hambitzer '631 is located **between** the positive and negative electrodes of Hambitzer '631 and **prevents** active mass from growing therethrough. As a result, the separator prevents active mass deposited on the negative electrode from growing up to the surface of the positive electrode. Therefore, even though active mass formed at the negative electrode during charge of the cell may penetrate into the pores of the porous salt structure of the additional salt of Hambitzer '631, the active mass is not capable of penetrating through the pores of the separator of Hambitzer '631 up to the surface of the positive electrode of Hambitzer '631.

Simply put, the presence of the separator in the Hambitzer '631, which is located between the positive and negative electrodes and **prevents** active mass from growing therethrough, prevents anything in the Hambitzer '631 from being "arranged and formed such that it is possible for active mass deposited on the negative electrode to grow during the charging of the cell through the pores of the insulator layer **up to the surface of the positive electrode**," as recited in claim 1. (emphasis added). Accordingly, the rejection of claim 1 is improper because Hambitzer '631 does not disclose the "porous insulator" recited in claim 1.

Hambitzer '631 also cites international patent application PCT/DE 00/00177, which corresponds to U.S. Patent No. 6,709,789 to Hambitzer et al. ("Hambitzer '789"). Hambitzer '631 at col. 5, lines 41-44. The disclosure of Hambitzer '789 is similar to the disclosure of Hambitzer '631 in that both are directed to the addition of salt to battery cells. Hambitzer '789 is explicit that, "[a]part from the salt 10 arranged in the area of the negative electrode, the [battery cell] design is conventional." Hambitzer '789 at col. 4, lines 10-12. The conventional design contains a separator 5 designed to prevent short-circuit reactions. Hambitzer '789 at col. 3, lines 49-59. Likewise, apart from the salt arranged in the area of the negative electrode of Hambitzer

'631, and the quantity of SO_2 relative to its maximum charge capacity, the battery cell design of Hambitzer '631, which includes a separator, is conventional. *See* Hambitzer '631 at col. 5, lines 1-10 and col. 7, lines 1-2. And, it is unreasonable to characterize Hambitzer '631 as disclosing the recited claim features when Hambitzer '631 has a conventional structure with a separator and is designed to prevent growth of active matter from the negative electrode to the positive electrode.

The Examiner asserts that "[t]he porous layer of Hambitzer ['631] is materially and structurally the same as that claimed in claim 1 and therefore is capable of performing the same." Office Action at p. 13. However, as explained above, the "porous insulator layer" recited in claim 1 is structurally different than the separator of Hambitzer '631 due to the size of the pores.

In addition, Hambitzer '631 does not disclose "an intermediate space between the positive electrode and the negative electrode is arranged and adapted such that active mass deposited on the negative electrode during the charging of the cell may come into contact with the positive electrode in such way that locally limited short-circuit reactions occur at its surface," as required by claim 1. The "arranged and formed" phrase limits the structure of the claimed "intermediate space" to only those structures that enable "active mass deposited on the negative electrode during the charging of the cell [to] come into contact with the positive electrode in such way that locally limited short-circuit reactions occur at its surface."

The Examiner alleges that an interface/surface between the positive electrode and the separator of Hambitzer '631 corresponds to the claimed "intermediate space." See Office Action

at pp. 4, 5 and 12.[3] There is no explicit disclosure of an "interface" or "surface" between the positive electrode and separator layer in Hambitzer '631. The Examiner, without any support, alleges that an "interface between the [positive] electrode and the [separator] layer ... is present on all batteries comprising these layers." *See* Office Action at p. 12. However, it is unclear how an interface/surface between the positive electrode and the separator of Hambitzer '631 could possibly correspond to the claimed "intermediate space."

One of ordinary skill in the art would not understand an interface/surface between the positive electrode and the separator of Hambitzer '631 to be "arranged and adapted such that active mass deposited on the negative electrode during the charging of the cell may come into contact with the positive electrode in such way that locally limited short-circuit reactions occur at its surface," as recited in claim 1. To begin, interface/surface between the positive electrode and the separator of Hambitzer '631 appears to be nothing more than the surface of the positive electrode itself. If that is the case, it is nonsensical for the Examiner to assert that the surface of the positive electrode is arranged in such way that locally limited short-circuit reactions occur at itself. Also, one of ordinary skill in the art would not understand a two-dimensional interface/surface to be an "intermediate space."

Moreover, one of ordinary skill in the art would not understand an interface/surface between the positive electrode and the separator of Hambitzer '631 to be "arranged and adapted such that active mass deposited on the negative electrode during the charging of the cell may

[3] The Examiner alleges that "the interface between the electrode and the porous insulator layer" corresponds to the claimed "intermediate space" feature. Office Action at p. 12. The Examiner asserted that the separator of Hambitzer '631 corresponds to the claimed "porous insulator." *See Id.* at p. 4. The Examiner also discussed "the surface of the positive electrode and the porous insulator." *Id.* at p. 5. Thus, it is believed that the Examiner is alleging that the interface/surface between the positive electrode and the separator of Hambitzer '631 corresponds to the to the claimed "intermediate space" feature.

come into contact with the positive electrode in such way that locally limited **short-circuit reactions** occur at its surface," as required by claim 1 (emphasis added) because Hambitzer '631 discloses that short circuits are **safety problems**, which are to be **avoided**. Hambitzer '631 at col. 4, lines 42-55.

One means to address the safety problem is the addition of salt having a porous structure. Hambitzer '631 at col. 5, lines 1-40. Hambitzer '631 discloses that "the porous structure should be formed and arranged in such a manner that the active mass which is formed at the negative electrode during the charge of the cell, penetrates into the pores of the porous salt structure." *Id.* at col. 5, lines 33-37. Hambitzer '631 also discloses that it is "generally preferred if at least during a part of the charge/discharge cycle of the cell there is contact of the salt to the negative electrode, in particular to an active mass formed at the electrode." *Id.* at col. 5, lines 19-23. Thus, although Hambitzer '631 discloses that active mass deposited on the negative electrode during the charging of the cell may come into contact **with the porous salt structure**, Hambitzer '631 does not disclose that "an intermediate space between the positive electrode and the negative electrode is arranged and adapted such that active mass deposited on the negative electrode during the charging of the cell may come into contact **with the positive electrode**," as is required by claim 1. (emphasis added).

Accordingly, Applicants respectfully request reconsideration and withdrawal of the rejection of claim 1.

Canceled Claims 2, 17 and 18

Claims 2, 17 and 18 were listed in the statement of the rejection even though the claims had been previously canceled without prejudice or disclaimer. Applicants respectfully request withdrawal of the rejection of the canceled claims.

Dependent Claims 3-6 and 30-34

Claims 3-6 and 30-34 depend on independent claim 1 and are patentable over Hambitzer '631 for the same reasons discussed above with regard to claim 1 as well as for the additional limitations they recite.

Independent Claim 19

Although claim 19 was listed in the statement of the rejection, claim 19 was not specifically addressed in the anticipation rejections. *See* Office Action at pp. 3-6. Applicants respectfully submit that claim 19 is not anticipated by Hambitzer '631 because Hambitzer '631 does not disclose each and every feature of claim 19. For example, Hambitzer '631 does not disclose "an electrode surface [of at least one of the positive and negative electrodes] which is essentially free of hydroxide ions," as required by the claim. The Examiner made no attempt to address this limitation, and the anticipation rejection of claim 19 is improper. Accordingly, Applicants respectfully request reconsideration and withdrawal of the rejection.

Dependent Claim 37

Claim 37 depends on independent claim 19 and is patentable over Hambitzer '631 for the same reasons discussed above with regard to claim 19 as well as for the additional limitation recited.

For example, claim 37 additionally recites that an "electrode [that] is essentially free of H^+ ions," as is required by claim 37. Applicants respectfully submit that Hambitzer '631 does not disclose, explicitly or inherently, this feature. The Examiner acknowledges that "Hambitzer ['631] does not specifically disclose wherein the electrode of claim 19 is essentially free of H+ ions." Office Action at p. 6. However, the Examiner alleges that the Hambitzer '631 inherently discloses an electrode having an electrode surface which is essentially free of H^+ ions because "the materials and structure of the battery of [Hambitzer '631] and the present application are the same." *Id.* Applicants' specification states that "'essentially free of OH − ions and/or H + ions' is to be understood to mean that the passivation of the electrode caused by the presence of the ions, and/or the resulting capacity loss, are reduced to such an extent that the required practical function of the electrode in a battery cell is not impaired thereby." Specification at page 11, lines 21-25. The materials of Hambitzer '631 are not the same as the materials of the present invention because Hambitzer '631 does not disclose that passivation of the electrode of Hambitzer '631 has been reduced to such an extent that the required practical function of the electrode in a battery cell is not impaired thereby. The reduced passivation is not an inherent feature of electrodes. Rather, in the present invention, the reduced passivation is achieved, for example, through use of the first cleaning component and/or second cleaning component. *See Id.* at page 12, line 6–page 15, line 10.

Furthermore, the experimental results described in the specification in relation to Figs. 5-8 prove that an electrode made of a particular material is not necessarily essentially free of H^+ ions. The H^+ ions referred to in claim 37 generally result from a reaction of water with the electrode material and cause a reduction of the original capacity of the active material. Fig. 7

shows the increased charging voltage of a cell in which passivation has not been reduced (curve B) and shows the essentially constant charging voltage of a cell in which passivation has been reduced (curve A). Similarly, Fig. 8 shows the increased initial capacity and less reduction in capacity by repeated charging of the cell in which passivation has been reduced (curve A) compared to the cell in which passivation has not been reduced (curve B). Therefore, the experimental results described in the specification in relation to Figs. 5-8 prove that an electrode made of a particular material is not necessarily essentially free of H^+ ions.

For these additional, independent reasons, Applicants respectfully submit that claim 37 is patentable over the cited prior art.

Further, it is noted that claim 19 is not addressed in the anticipation rejections but is addressed in the obviousness rejections discussed below. However, claim 37, which is dependent on claim 19, is not rejected in the obviousness rejections. If the Examiner intended to reject claim 37 as obvious and still considers the obviousness rejection to be proper, Applicants respectfully request that the Examiner reopen prosecution and issue an obviousness rejection of claim 37 so that Applicants may address the rejection and fully develop the record for appeal.

Dependent Claims 38-48

Claims 38-46 depend on independent claim 19 and are patentable over Hambitzer '631 for the same reasons discussed above with regard to claim 19 as well as for the additional limitation recited. Claims 47 and 48 depend on independent claim 1 and are patentable over Hambitzer '631 for the same reasons discussed above with regard to claim 1 as well as for the additional limitation recited. Further, like claim 19, claims 38-45, 47 and 48 were not addressed in the anticipation rejections. *See* Office Action at pp. 3-6.

Rejection of Claims under 35 U.S.C. § 103

Dependent Claims 7 and 8

Claims 7 and 8 were rejected under 35 U.S.C. § 103(a) as being unpatentable by reasons of obviousness over Hambitzer '631. Applicants respectfully traverse for the following reasons.

Claims 7 and 8 depend on independent claim 1. As a result, claims 7 and 8 are patentable over Hambitzer '631 for the same reasons discussed in regard to claim 1. Claims 7 and 8 are also patentable over Hambitzer '631 for the additional limitations they recite. For example, claim 7 recites that "the porous insulator layer contains a particle-shaped, fiber-shaped or tube-shaped pore structure material." The Examiner admits that Hambitzer '631 does not disclose this feature. Office Action at p. 6. Instead of relying on Hambitzer '631, the Examiner asserts the claimed particular shapes of the pore structure material would have been obvious. Specifically, the Examiner cites *In re Dailey* and asserts that "the courts have held that regarding changes in shape of the pores of the insulator would be obvious absent persuasive evidence that the particular configuration of the claim was significant." Office Action at pp. 6-7 (citing *In re Dailey*, 357 F.2d 669, 149 USPQ 47 (CCPA 1966)).

Contrary to the Examiner's assertion, *In re Daily* did **not** hold that changes in shape of the pores of an insulator would be obvious absent persuasive evidence that the particular configuration of the claim was significant. *In re Daily* involved a disposable plastic nursing container and had nothing to do with pores of insulators. Instead, according to the MPEP, the court in *In re Daily* "held that the configuration of the claimed disposable plastic nursing container was a matter of choice which a person of ordinary skill in the art would have found

obvious absent persuasive evidence that the particular configuration of the claimed container was significant." MPEP 2144.04(IV)(B).

Here, the particular configuration/shape of the pore structure material of the claimed "porous insulator layer" is significant because the shape of the pore structure affects whether "the electrolyte solution penetrates easily into the [porous insulator] layer." *See* Specification at page 8, lines 16-24. Accordingly, the particular claimed shapes of the porous insulator layer would not have been obvious a person of ordinary skill in the art as simply a matter of choice.

Also, because the prior art saw disadvantage in and specifically taught away from permitting active mass deposited on a negative electrode to come into contact with a positive electrode of a battery cell, one of ordinary skill in the art would not have found it obvious to design a battery cell to permit such contact. And further, for the same reason, one of ordinary skill in the art certainly would not have found it obvious to design pores of an insulator layer to permit growth of the active mass therethrough.

In responding to Applicants' arguments, the Examiner asserts that "Hambitzer teaches it would be obvious to change the formation of the pore structure." Office Action at p. 13. However, no support is provided for the Examiner's assertion, and nothing in Hambitzer addresses **changing** the formation of pore structure. The Examiner also asserts that "[t]he claimed pore shapes are common pore shapes found within porous structures made of particles or fibers." *Id.* Here again, no support is provided for the Examiner's assertion. The Examiner then asserts that "[t]he present specification does not provide any basis for forming the specific pore shapes that would lead one of ordinary skill in the art to the novelty of the different pore shapes." *Id.* Applicants are unable to make sense of this assertion. There is no requirement that a

specification must lead one of ordinary skill in the art to the novelty of an invention. The claim recites that "the porous insulator layer contains a particle-shaped, fiber-shaped or tube-shaped pore structure material." The significance of the recited shapes, as disclosed by Applicants' specification, is discussed above, and none of the cited prior art teaches or suggests the recited shapes. Therefore, the rejections are improper regardless of whether Applicants' specification would lead one of ordinary skill in the art to the novelty of the different pore shapes.

Accordingly, the rejection of claims 7 and 8 is improper for this additional, independent reason, and reconsideration and withdrawal are respectfully requested.

Dependent Claim 9

Claim 9 was rejected under 35 U.S.C. § 103(a) as being unpatentable by reasons of obviousness over Hambitzer '631 in view of U.S. Patent No. 4,283,469 to Goebel et al. ("Goebel"). Applicant respectfully traverses this rejection because Goebel does not overcome the deficiencies of Hambitzer '631 explained above in regard to claim 1. Therefore, claim 9 is patentable over Hambitzer '631 in view of Goebel for the same reasons discussed in regard to claim 1 as well as for the additional limitations claim 9 recites.

Claims 19 and 38-48

Claims 19 and 38-48 were rejected under 35 U.S.C. § 103(a) as being unpatentable by reasons of obviousness over International Publication No. WO 00/44061 to Hambitzer *et al.* ("Hambitzer '061") with the corresponding U.S. Patent No. 6,709,789 serving as the English equivalent,[4] in view of U.S. Patent No. 6,596,440 to Gavelin *et al.* ("Gavelin"). Applicants

[4] As in the Office Action, cites to the text of Hambitzer '061 refer to U.S. Patent No. 6,709,789.

respectfully traverse the rejections and submits that the claims are patentable over the cited references.

The rejection of claim 19 is improper because Hambitzer '061 and Gavelin, alone or in combination, fail to teach or suggest each and every feature of amended claim 19. For example, neither Hambitzer '061 nor Gavelin teaches or suggests that "at least one of … positive and negative electrodes has an electrode surface which is essentially free of hydroxide ions," as recited in claim 19.

The Examiner acknowledges that "Hambitzer ['061] does not specifically disclose wherein an electrode has an electrode surface which is essentially free of hydroxide ions." Office Action at pp. 7-8. Instead, the Examiner relies on Gavelin as teaching in col. 5, lines 39-56, that "it is important to reduce growth of the passivation films which in turn results in improved battery performance when the electrolyte is applied to the battery." Office Action at p. 8. The Examiner then asserts that:

> At the time of the invention, it would have been obvious to one of ordinary skill in the art to **modify** the battery of Hambitzer ['631] **by reducing the growth of the passivation films at the electrode surfaces**, because Gavelin … recognizes that such films decrease performance of lithium secondary batteries. Furthermore, it is the position of the Examiner that properties such as the electrode surfaces being free from hydroxide ions are **inherent, given that the materials and structure** of the battery of Hambitzer ['631] and Gavelin … and the present invention **are the same**.

Office Action at p. 8 (emphasis added).

The rejection of claim 19 is improper because **(1)** a teaching of the desirability to reduce passivation **in general** is **<u>not</u>** a teaching or suggestion of "an electrode surface which is

essentially free of hydroxide ions," as recited in claim 19, and **(2)** the **materials and structure** of Hambitzer '631 and Gavelin are **not the same** as the structure of the cell of claim 19.

1. General Teaching is Not a Specific Teaching

In regard to the Examiner's reliance on the general teaching of Gavelin, the invention of Gavelin "concerns a polymer electrolyte." Gavelin at col. 5, lines 17-24. Gavelin discloses that:

> In addition to an improved conductivity when using the **polymer electrolyte** concept of the present invention, an improved compatibility towards die electrode surfaces can be addressed by the amphiphilic graft copolymer in, the electrolyte. It is commonly believed that anionic species can form **oligomers** on the electrode surfaces and these organic species are not evenly distributed on the electrode surfaces, but are thought to form domains of varying thickness. These domains are commonly regarded as parts of the second passivation layer formed during cycling of the lithium polymer battery. **Reducing the growth of these oligomers means reducing passivation films and this will result in improved battery performance when the electrolyte is applied in a lithium polymer battery.** The amphiphilic nature of the copolymer, having strong hydrophobic and hydrophilic grafts, results in a self-organizing effect of the grafts in the electrolyte reducing the passivation phenomena at the electrode surfaces.

Id. at col. 5, lines 39-56 (emphasis added). Thus, Gavelin refers to the problem of electrode passivation, but with completely different materials, namely with a polymer electrolyte. In this context, electrode passivation is reduced by using an amphiphilic graft copolymer having a specific structure as claimed in claims 1 and 8 of Gavelin.

The only similarity is reference to passivation phenomena at the electrode surfaces. Of course electrode passivation is a general problem in the battery art and any skilled person would aim to reduce same. However, claim 19 does not merely recite an electrode surface of an electrode at which passivation has been reduced. To the contrary, claim 19 recites an electrode surface of an electrode at which passivation has been reduced in a specific way. In particular, claim 19 specifies that the "electrode surface ... is **essentially free of hydroxide ions**."

(emphasis added). None of the cited prior art, including Gavelin, teaches or suggests "an electrode surface which is essentially free of hydroxide ions."

To be clear, Gavelin's teaching of the desirability to reduce passivation **in general** is **not** a teaching or suggestion of "an electrode surface which is essentially free of hydroxide ions," as recited in claim 19. Likewise, the specific manner of reducing passivation taught by Gavelin (*i.e.*, electrode surface having reduced growth of oligomers) is very different than and in no way a teaching or suggestion of "an electrode surface which is essentially free of hydroxide ions," as recited in claim 19.

Furthermore, even if the growth of oligomers on the surface of the electrode of Hambitzer '061 were reduced, as is apparently proposed by Examiner, it is unclear why the Examiner believes that the reduction in oligomer growth would result in the electrode of Hambitzer '061 being inherently "essentially free of hydroxide ions," as recited in claim 19. Certainly, an electrode surface having a reduced growth of oligomers is not inherently (*i.e.*, necessarily) "essentially free of hydroxide ions."

Applicants' specification refers specifically to cells operating with a special type of inorganic battery cells, namely cells operating with a SO_2-based electrolyte. Applicants' specification at page 10, line 20-page 11, line 31. In this specific context, the invention is based on the surprising finding of the inventors that the passivation of electrodes may be attributed to a reaction of the surface molecules of the electrode with water (*e.g.*, from ambient humidity) resulting in the formation of a cover layer which contains a hydroxide of the active metal.

The invention could not have been made without this finding and nothing in Gavelin provides the slightest hint in this direction. Rather, Gavelin discloses that, in cells using the

"polymer electrolyte concept," the passivation is attributed to the formation of oligomers which are an organic species forming domains. Gavelin at col. 5, lines 39-56. The invention of Gavelin is based on the reduction of the growth of these oligomers. One of ordinary skill in the art would have readily understood that the reduction of organic oligomers has no applicability to an inorganic "electrolyte ... based on SO_2" recited in claim 19.

2. The Materials and Structure are Not the Same

In regard to the materials and structure, the materials and structure of the combination of Hambitzer '061 and Gavelin and the product of claim 19 are not the same and, therefore, no inherent disclosure can be present. To begin, an electrode surface is not inherently essentially free of hydroxide ions. For example, Applicants' specification discloses removing "OH^- ions ... from the electrodes using a cleaning agent which contains a first cleaning component reacting with OH − ions." Applicants' specification at p. 10, lines 12-18. Furthermore, the experimental results described in the specification in relation to Figs. 5-8 establish the difference between an electrode having reduced passivation and an electrode in which passivation has not been reduced. The hydroxide ions referred to in claim 19 cause "passivation" of the electrode, resulting in an increase of the internal resistance of the cell and an unfavorable reduction in capacity over a plurality of charging and discharging cycles. Fig. 7 shows the increased charging voltage of a cell in which passivation has not been reduced (curve B) and shows the essentially constant charging voltage of a cell in which passivation has been reduced (curve A). Similarly, Fig. 8 shows the increased initial capacity and less reduction in capacity by repeated charging of the cell in which passivation has been reduced (curve A) compared to the cell in which passivation has not been reduced (curve B). Therefore, the experimental results described in the

specification in relation to Figs. 5-8 prove that an electrode made of a particular material is not necessarily essentially free of hydroxide ions. Also, an electrode having a surface that is **not** "essentially free of hydroxide ions" is **not the same** as an electrode having a surface that **is** "essentially free of hydroxide ions."

The Examiner acknowledges that "Hambitzer ['061] does not specifically disclose wherein an electrode has an electrode surface which is essentially free of hydroxide ions." Office Action at pp. 7-8. Instead of attempting to rely on inherence, the Examiner proposes a combination in which the electrode surface of Hambitzer '061 is "modif[ied]" in accordance with the teachings of Gavelin. Office Action at p. 8. However, Gavelin discloses reducing the growth of oligomers on the surface of an electrode. Gavelin does not teach or suggest "an electrode surface which is essentially free of hydroxide ions." Even if the growth of oligomers on the surface of the electrode of Hambitzer '061 were reduced, the electrode of Hambitzer '061 would not be "essentially free of hydroxide ions," as recited in claim 19.

In addition, Gavelin clearly teaches an organic polymer electrolyte **completely different** from the inorganic SO_2-based electrolyte recited in claim 19. Gavelin refers to polymer electrolytes and to a battery cell containing such an electrolyte. In particular he refers to lithium ion secondary batteries. Gavelin at col. 1, lines 66-67. Gavelin explains that, in these cells, organic liquid electrolytes are used and that these electrolytes provide high conductivity (thereby high battery cell currents), but are also the cause of problems, (*e.g.*, leakage of the electrolyte out of the battery, vaporization of the solvent of the electrolyte, and dissolution of the electrode material in the electrolytic solution). *Id.* at col. 2, lines 7-13. Gavelin then goes on to explain that, in order to address the problem of leakage, solid polymer electrolytes have been proposed,

but that conventional solid polymer electrolytes have insufficient ionic conductivities which are between 1 and 3 orders of magnitude lower than an acceptable value of 10^{-3} S/cm. *Id.* at col. 2, lines 21-32. Gavelin furthermore explains that, compared to polymer electrolytes, better electrical conductivity is achieved by polymer gel electrolytes formed by tapping an electrolyte (*i.e.*, an organic solvent mixture containing dissolved lithium salt, in a polymer matrix). *Id.* at col. 2, lines 47-49. With respect to this type of electrolyte Gavelin notes mainly two drawbacks:

(a) It is a two-phase material which does not offer sufficient long-term stability due to phase separation. *See Id.* at col. 2, line 63-col. 3, line 1.

(b) The reliability of the battery cells is reduced because conventional polymer gel electrolytes have poor chemical compatibility with the electrodes. The reason for this poor compatibility is "the build-up of passivation films, mainly at the interfaces between the negative electrode and the polymer gel electrolyte, because of the high content of organics solvent." The passivation film has two layers, namely an inorganic first layer and an organic second layer. A special problem with the second layer is, according to Gavelin, that it "increases in thickness with cycling of the battery cell, and this increase is regarded as the main problem when using polymer gel electrolytes … ." *See Id.* at col. 3, lines 1-15.

On this basis, Gavelin proposes a new type of polymer electrolyte comprising a polymer, a metal salt (*i.e.*, conducting salt), and optionally at least one plasticizer or solvent. Gavelin's polymer has a specific structure, namely an amphiphilic graft copolymer comprising a backbone on which both hydrophilic and hydrophobic grafts are attached to different carbon atoms. Examples of suitable conducting salts are listed in col. 9, lines 38-57.

Effects achieved by Gavelin's invention are described in columns 5-7. As noted above, Gavelin refers to the above explained problem regarding the compatibility of the polymer with the electrode surface, noting that:

> anionic species can form oligomers on the electrode surface and these organic species are not evenly distributed on the electrode surface but are thought to form domains of varying thickness. These domains are commonly regarded as parts of the second passivation layer formed during cycling of the lithium polymer battery. Reducing the growth of these oligomers means reducing passivation films and this will result in improved battery performance when the electrolyte is applied in a lithium polymer battery. The amphiphilic nature of the copolymer, having strong hydrophobic and hydrophilic grafts, results in a self-organizing effect of the grafts in the electrolyte reducing the passivation phenomena at the electrode surfaces.

Id. at col. 5, lines 43-56. In regard to this effect, Gavelin further explains that "[t]he amphiphilic graft copolymers will interact advantageously with the solvent or plasticizer of the electrode surfaces, which results in a decrease of the growth of the passivation film with an improved capacity of the whole battery system as a result." *Id.* at col. 7, lines 30-34.

On this basis it becomes very clear that Gavelin differs from the present invention in a plurality of ways:

(a) Gavelin refers to organic electrolytes as used in conventional lithium ion batteries. In contrast, claim 19 recites an inorganic SO_2-based electrolyte solution. According to Applicants' specification, "[a]n electrolyte is designated as 'SO_2-based' if it contains SO_2 not only as an additive in low concentrations, but rather the mobility of the ions of the conductive salt which is contained in the electrolyte and causes the charge transport, is at least partially ensured by the SO_2." Applicants' specification at p. 4, line 35-p. 5, line 3.

(b) Gavelin addresses a type of passivation which is specific to organic electrolytes, namely generation of a passivation layer of organic nature which increases in thickness with cycling of the battery cell. This has nothing to do with a passivation effect caused by OH^- ions or by H^+ ions in an inorganic cell.

(c) The effect of reduced passivation is, in the case of Gavelin, explained by a reduction of the growth of oligomers, which Gavelin discloses as the cause of the passivation. This has nothing to do with the basic finding of the invention according to which in the specific context of a SO_2-based battery cell, passivation is caused by the presence of OH^- ions and H^+ ions.

As the teachings of Gavelin are only applicable to polymer electrolyte, the electrolyte of the combination of Hambitzer '061 and Gavelin must also be a polymer electrolyte and not the "electrolyte ... based on SO_2," as recited in claim 19. Accordingly, the Examiner's allegation of inherent disclosure is improper because the essential materials and functions are substantially different. As noted above, the inventors recognized for the first time that, in this specific case of a SO_2-based electrolyte, the electrode passivation may be attributed to a reaction of the surface molecules of the electrode with water (e.g. from ambient humidity), resulting in the formation of a cover layer which contains a hydroxide of the active metal. The invention could not have been made without this finding and Gavelin provides no information which would even be remotely similar.

Gavelin lists of several salts including sulfinate groups that can be used for the preparation of the polymer electrolyte. Gavelin at col. 9, lines 38-57. Although not cited in the Office Action, the Examiner mentioned these salts and the sulfinate groups in attempting to

explain his position on why the teaching of Gaveling would be applicable to a SO_2-based electrolyte. The salts to which Gavelin refers can be used as components of the polymer electrolyte solution, namely as **conducting salt**. Some of the chemical formulae listed in the document include "SO_2." However, these are **sulfinate groups** as part of one of the ions of the described salts. Nothing is mentioned about **sulfur dioxide**, which is the compound on which the claimed electrolyte is based. Also, nothing is mentioned about using sulfur dioxide as a compound for any function of a battery cell. Therefore, the polymer electrolyte solution is not an "electrolyte ... based on SO_2," as recited in claim 19, and the teaching of Gavelin would not be relevant to the invention of claim 19. It is very basic knowledge of chemistry that functions of a certain compound, such as sulfur dioxide (*i.e.*, SO_2), and a group containing the same atoms in a larger molecule, such as a sulfinate group, have **nothing** to do with each other.

This is further illustrated by comparing a gaseous molecule to a substance comprising the atoms of the gaseous molecule. There are gaseous substances which consist only of a few atoms. For example, carbon dioxide $C0_2$, carbon monoxide CO, hydrogen sulfide H_2S and sulfur dioxide SO_2 are each gaseous substances consisting of only a few atoms. Because of the low molar mass and the stable inner bondings, these molecules are gaseous.

In some cases these simple molecules can build weak interactions with other substances and their physical condition changes from gaseous to liquid. Because there is no chemical bonding between the molecule and the other substance, the physical and chemical properties of the molecule don't change. If you separate the molecule and the substance from each other, you get the initial materials.

An example for this is the electrolyte described in Applicants' invention. Gaseous sulfur dioxide interacts with solid salt Lithiumtetrachloroaluminate and a liquid results. There are no chemical bondings between the salt and the sulfur dioxide. If you heat the liquid, the interaction between the two substances become weaker and you get a separation in the gas and the salt again.

In the organic chemistry there are many possibilities to create molecules with specific properties. For carbon chains, there are different functional groups at the C atoms. For example, acetic acid is formed when ethanol is oxidized (*i.e.*, $CH_3COH + O = CH_3CO_2H$). Because of the different groups at the second C atom, the first substance has the properties of an alcohol and the second the properties of an acid. The alcohol comprises the bonded atoms C-0. It is the same composition like in carbon monoxide CO. However, the alcohol has no chemical properties similar to the properties of carbon monoxide, because the chemical environment is different. Further, the same applies to the acid. There is the combination of one C atom and two O atoms to a $C0_2$-group, but you can't find the properties of carbon dioxide within the acid molecule.

The Gavelin patent describes conducting salts with different functional groups. There are salts which comprise a Sulfinate group $S0_2$. Here again, the existence of the one S atom bonded to two O atoms does not imply that the Sulfinate group in the conducting salt shares any of the same properties as a sulfur dioxide molecule. Accordingly, one of ordinary skill in the art would not expect the teaching of Gavelin to be relevant to the battery cell of claim 19 having an "electrolyte … based on SO_2."

Moreover, Gavelin's disclosure concerning the potential usefulness of a species as a **conducting salt cannot be transferred** to a potential usefulness as a **solvent** of an electrolyte

solution. As is explained in the attached portion of the Handbook of Battery Materials ("Handbook"), an electrolyte for batteries is an ion conducting solution which consists of a solvent S and a salt, in the case of a lithium battery a lithium salt. Handbook at p. 457, left column. The two constituents are discussed in the following sections 7.2.1 and 7.2.2 of the Handbook. On page 459, left column, a plurality of classes of potential solvents is listed. Page 460 provides a table of solvents used for lithium batteries including several organic compounds (as used by Gavelin) and also sulfur dioxide. The requirements regarding salts are listed in the first paragraph of section 7.2.2 on page 461 and examples are given later in this section. Not a single important property or requirement regarding a solvent is the same as with a conducting salt. Both are simply distinct elements of an electrolyte solution fulfilling different requirements. As such, one of ordinary skill in the art would not expect the teaching of Gavelin to be relevant to the battery cell of claim 19 having an "electrolyte ... based on SO_2."

For these reasons, the rejection of claim 19 is improper, and Applicants respectfully request reconsideration and withdrawal.

Claims 38-46 depend on independent claim 19 and are patentable over Hambitzer '061 in view of Gavelin for the same reasons discussed in regard to claim 19.

Claims 47 and 48 depend on independent claim 1. Although the Examiner alleges that Hambitzer '061 discloses the subject matter of claims 47 and 48, the **Examiner failed to address how Hambitzer '061 and Gavelin, alone or in combination, teach or suggest the features of claim 1**. Instead, the Office Action only addresses claim 1 in the rejection of claim 1 as anticipated by Hambitzer '631. The rejections of claims 47 and 48 are improper at least because Hambitzer '061 and Gavelin, alone or in combination, fail to teach or suggest each and

every feature recited in claim 1. For example, neither Hambitzer '061 nor Gavelin teaches nor suggests "an intermediate space between the positive electrode and the negative electrode is arranged and adapted such that active mass deposited on the negative electrode during the charging of the cell may come into contact with the positive electrode in such way that locally limited short-circuit reactions occur at its surface," as recited in claim 1. In addition, neither Hambitzer '061 nor Gavelin teaches nor suggests "a porous insulator ... arranged and formed such that it is possible for active mass deposited on the negative electrode to grow during the charging of the cell through the pores of the insulator layer up to the surface of the positive electrode," as recited in claim 1. Accordingly, the rejections of claims 47 and 48 are improper, and Applicants respectfully request reconsideration and withdrawal.

Withdrawn Independent Claim 49

For the reasons explained above, the election/restriction requirement and withdrawal of claim 49 were improper. Claim 49 has not been examined on the merits. Applicants respectfully request that the Examiner reopen prosecution and examine claim 49 on the merits.

Applicants respectfully submit that claim 49 is patentable over the cited prior art. None of the cited references disclose or suggest an "an insulator means for permitting active mass deposited on the negative electrode during the charging of the cell to come into contact with the positive electrode in such way that locally limited short-circuit reactions occur at its surface," as is required by claim 49.

Conclusion

All of the stated grounds of rejection have been properly traversed or rendered moot. Applicants therefore respectfully request that the Examiner reconsider all presently outstanding rejections, and that they be withdrawn. Applicants submit that a full and complete reply has been made to the outstanding Office Action and, as such, the present application is in condition for allowance.

The Applicants respectfully petitioned for a one-month extension of time. Any fees for the extension together with any additional fees may be charged to Counsel's Deposit Account No. 02-2135.

If for any reason the Examiner determines that the application is not now in condition for allowance, it is respectfully requested that the Examiner contact, by telephone, the Applicants' undersigned attorney at the indicated telephone number to arrange for an interview to expedite the disposition of this application.

Respectfully submitted,

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